(12) UK Patent Application (19) GB (11) 2 069 531 A

(21) Application No 8004840
(22) Date of filing 13 Feb 1980
(43) Application published 26 Aug 1981
(51) INT CL³ B23P 1/14
(52) Domestic classification C7B 151 203 265 DB
(56) Documents cited GB 1496916 GB 1495710 GB 1170644 GB 881167 GB 748485
(58) Field of search C7B
(71) Applicants The Production Engineering Research Association of Great Britain, Melton Mowbray, Leicestershire, LE13 0PB
(72) Inventor Arthur Ivan Walter Moore
(74) Agents E. N. Lewis & Taylor, 144 New Walk, Leicester, LE1 7JA

(54) **Electro-chemical machining**

(57) During an electro-chemical machining process in which a tool and a workpiece are used as respective electrodes, the tool and the workpiece are held in spaced relationship by means of at least one electrically insulating spacer which contacts both the tool and the workpiece. As shown the spacer 24 is attached to the tool 20 operating on workpiece 16a. Alternatively the spacer can be attached to the workpiece or a workpiece fixture.

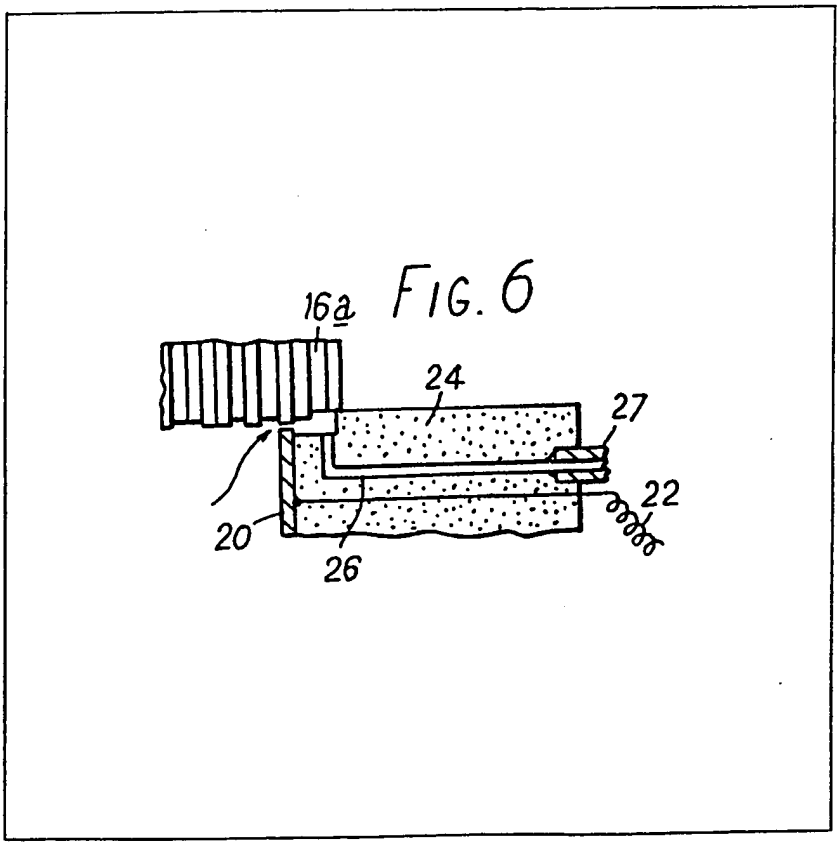


FIG. 6

GB 2 069 531 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

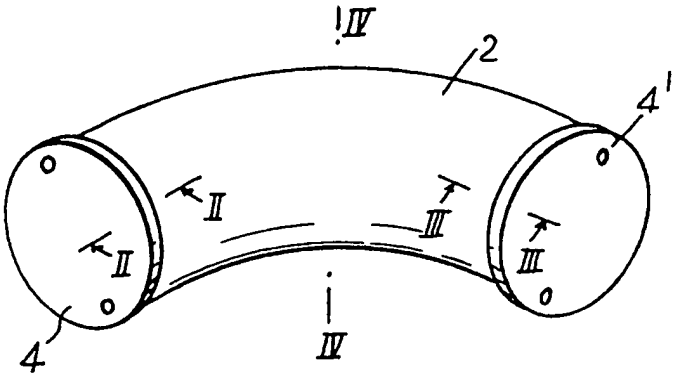


FIG. 1

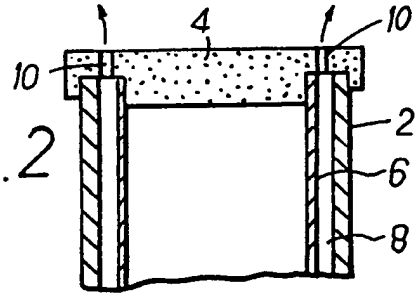


FIG. 2

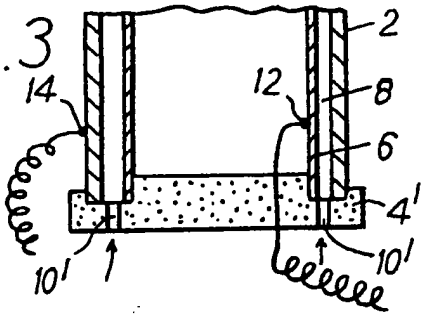


FIG. 3

FIG. 4

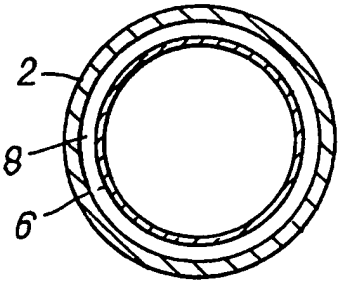
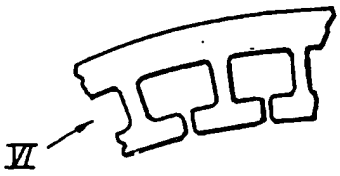


FIG. 5



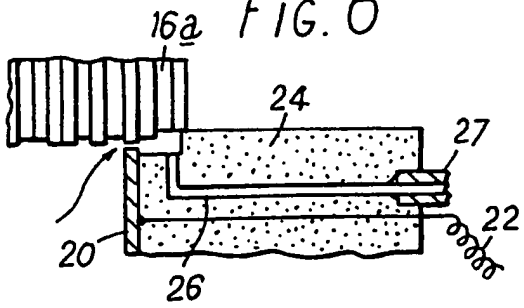


FIG. 6

2069531

FIG. 7

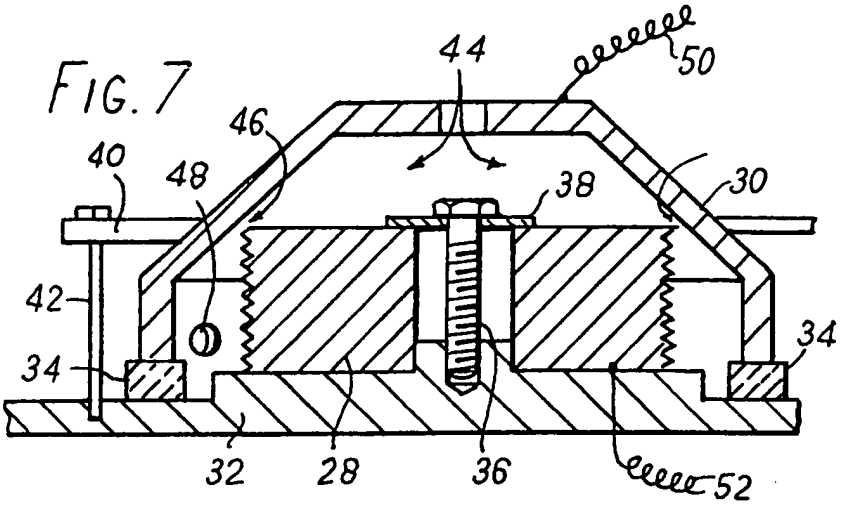


FIG. 8

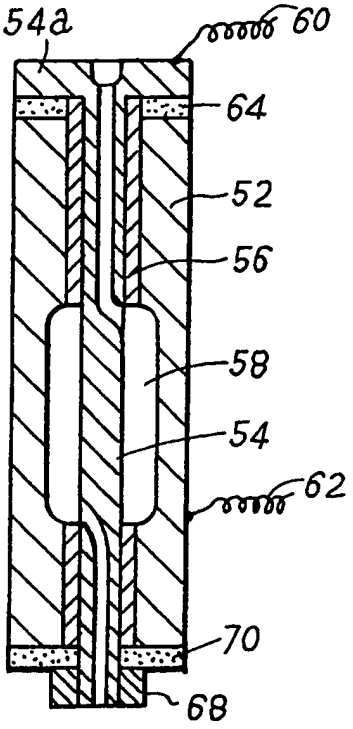


FIG. 9

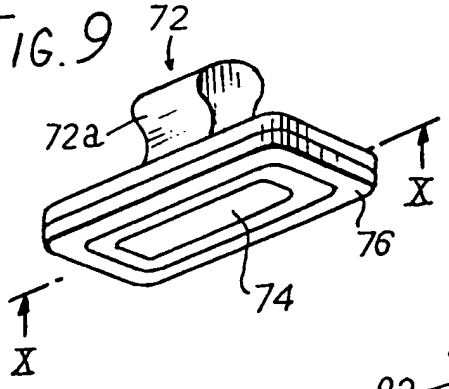
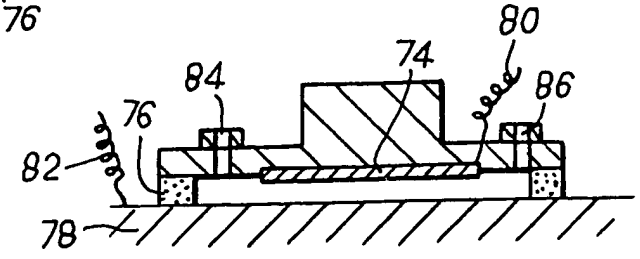


FIG. 10



SPECIFICATION

El ctro-chemical machining

The invention relates to a method of electro-chemically machining a workpiece.

It is well known in the art of electro-chemical machining to provide a machine tool to position a tool used as a cathode with respect to a workpiece to be machined, used as an anode. In cases where relatively large amounts of the workpiece are to be removed, it is known to feed the tool towards the workpiece by means of the machine tool as the workpiece is eroded. Often the workpiece may be preformed or premachined to facilitate electro-chemical machining.

The present invention provides a method of electro-chemical machining in which a tool and a workpiece used as respective electrodes are held in spaced apart relationship by means of at least one electrically insulating spacer.

The electrically insulating spacer may be attached to the tool, the workpiece, or a workpiece fixture. Desirably, the tool remains stationary with respect to the workpiece while electro-chemical erosion takes place. In certain circumstances, however, relative movement or incremental positioning may be effected manually. In either case it is not necessary to provide a machine tool.

The present invention is particularly suitable for machining, deburring or polishing workpieces.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a perspective view of a pipe elbow whose internal surface is to be machined by a method according to the present invention;

Fig. 2 is a part cross-section on line II—II of Fig. 1;

Fig. 3 is a part cross-section on line III—III of Fig. 1;

Fig. 4 is a cross-section on Line IV—IV of Fig. 1;

Fig. 5 is an elevational view of part of a stator for an electric motor made up of a number of laminations;

Fig. 6 is a schematic side view in the direction of arrow 6 showing a method according to the present invention being used to machine laminations of the stator shown in Fig. 5;

Fig. 7 is a schematic cross-sectional view of an assembly for electro-chemically machining the start threads of a multi-start thread rolling dye using a method according to the present invention;

Fig. 8 is a cross-sectional view of an assembly for machining a chamber within a workpiece using a method according to the present invention;

Fig. 9 a perspective view from below showing a hand-held tool for use in electro-chemical polishing of a surface by a method according to the present invention; and

Fig. 10 is a cross-sectional view on line X—X of Fig. 9.

Referring first to Figs. 1 to 4, a pipe elbow 2 has end caps 4 and 4′ made of electrically insulating material which act as spacers for a tubular tool 6 mounted within the elbow, such that the tool 6 is spaced from an internal wall of the elbow 2 leaving a generally annular space 8 therebetween. A pair of ports 10 in the end cap 4 and a similar pair of ports 10 in the end cap 4′ communicate with the space 8 and allow electrolyte to be passed through the latter during electro-chemical machining, electrically being supplied to the tool 6 and the elbow 2 by way of respective connections 12 and 14.

It will be manifest that the electrically insulating end caps 4 and 4′ serve to space the tool 6 from the elbow 2 during electro-chemical machining.

Fig. 5 shows part of a typical stator 16 for an electric motor. Such stators are generally made up from a series of laminations 16a as shown on Fig. 6, and in the case of large motors it often occurs that the laminations are not uniformally aligned, producing irregular sharp edges on the stator. There is a danger that the insulation of insulated wires when wound on the stator will be damaged by these edges if they are not straightened out. Fig. 6 shows these edges being removed by means of an electro-chemical machining process using a tool which is moved manually along each stator slot in turn.

The laminations 16a are connected to a power supply by means of an electrical lead 18, and machining is performed using an electrode 20 connected to a power supply by means of an electrical lead 22. The electrode 20 is mounted on a body 24 of electrically insulating material which is held in contact with the laminations 16a, such that the electrode is spaced a small distance from the deepest of the laminations. The body 24 has a passage 26 therein through which electrolyte can be supplied via an inlet port 27 to the space between the electrode and the laminations.

The electrically insulating body 24 thus acts to space the electrode 20 from the laminations 16a during electro-chemical machining.

In Fig. 7 the workpiece for electro-chemical machining is a multi-start thread rolling die 28. In order to provide lead-in threads for the die it is necessary to machine the upper edges of the die to an acute angle. This is accomplished by using a bell-shaped housing 30 spaced from a base plate 32 by means of electrically insulating material 34, the die 28 being rigidly clamped to the base plate 32 by means of a clamping screw 36 and a clamping plate 38. The housing 30 is held in position by means of a clamping ring 40 which is screwed to the base plate 32 by means of a number of screws 42 (only one of which is shown). Electrolyte enters the housing 30 through a port 44 and passes through a machining gap 46 between the housing 30 and an edge of the die 28 before leaving the housing 30 through an exit port 48. An electric potential is applied between the housing 30 and the die 28 by means of electrical connections 50 and 52 to achieve electro-chemical erosion of the die.

The electrically insulating material 34 thus

spaces the housing 30 from the die 28 during the electro-chemical machining process.

In Fig. 8 a cylindrical workpiece 52 is provided with a cylindrical bore into which a hollow electrode 54 is inserted, the electrode being spaced from internal walls of the workpiece 52 by means of electrically insulating bushes 56, which are interposed between the electrode and the workpiece at upper and lower portions thereof. In a central region of the electrode 54, a machining gap 58 is provided between the bushes, and the hollow electrode allows entrance and exit of electrolyte material through the machining gap 58. The achieve machining, an electrical potential is applied between the electrode and the workpiece by means of connections 60 and 62 respectively. An end 54a of the electrode overlies an end face of the workpiece 52 and is spaced therefrom by means of an electrically insulating washer 64. An opposite end of the electrode is clamped against an opposite end of the workpiece 52 by means of a clamp nut 68, said nut being spaced from the end of the workpiece by means of an electrically insulating washer 70.

During electro-chemical machining, to provide or enlarge a central chamber in the workpiece, the electrode 54 is held in spaced relationship to the workpiece 52 inter alia by means of the electrically insulating bushes 56.

In Figs. 9 and 10 there is shown a hand tool 72 having a hand grip 72a and an electrode 74 in an undersurface thereof. A raised electrically insulated surround 76 is provided around the electrode 74 on the undersurface of the hand tool 72 so that when the hand tool is placed on a flat workpiece 78 the electrode 74 is spaced from the workpiece by a small amount. Electrical connections are made to the electrode 74 and the workpiece 78 by means of respective connections 80 and 82. The hand tool is provided with inlet and outlet ports 84 and 86 respectively for electrolyte.

In operation of all the above devices when an electric potential is applied between the workpiece and the tool electrode, and electrolyte is passed therebetween electro-chemical erosion of the workpiece takes place and thus machining is achieved.

It will be noted that in all of the above examples the electrode and workpiece are held in spaced apart relationship by means of at least one electrically insulating spacer. Preferably, the or each spacer is made of a material such as TUFNOL (Registered Trade Mark) but any suitable material may be used.

It will be noted that the use of a machine tool is not required for the method of the invention.

CLAIM

A method of electro-chemical machining in which a tool and a workpiece used as respective electrodes are held in spaced apart relationship by means of at least one electrically insulating spacer.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.